Timescale of Regional Plains Emplacement on Venus Geoffrey C. Collins[1], James W. Head[1], Mikhail A. Ivanov[2], and Alexander T. Basilevsky[2]. [1]Brown University, Dept. of Geological Sciences, Providence, RI 02912, [2]Vernadsky Institute, Russian Academy of Sciences, Moscow, Russia; Geoffrey_Collins@brown.edu.

An outstanding question in the Venus resurfacing debate is the length of time over which a theoretical "catastrophic" resurfacing event may have occurred. The emplacement of the wrinkle ridged plains over ~70% of the planet occurred synchronously over large areas [1,2] and was an important part of the global event. The length of time over which the wrinkle ridged plains were emplaced can be constrained by the number of creaters which they embay. Most of the embayed craters on Venus are embayed by lobate plains from local volcanic sources, and only 5-8 craters are embayed by the vast regions of wrinkle ridged plains [3]. The model of Strom et al. [4] estimates the length of the resurfacing episode based on how many craters it embayed, but this model was based on resurfacing by small, randomly distributed volcanic flows. This does not agree with observations of the nature of the wrinkle ridged plains, which the plains appear to be simultaneously emplaced over extensive areas [2]. Here we develop a simple statistical model based on the plains flooding of extensive areas in order to constrain the length of time over which they were emplaced.

One end-member model would be to assume that these 5-8 craters embayed by wrinkle ridged plains represent the entire population of craters on the surface below the plains. This implies that all of the wrinkle ridged plains are thin enough that they did not completely bury the smallest craters. On the other extreme, the plains could have buried all preexisting craters, and the embayed craters we see were formed on the plains during their emplacement. The relative roles of these two end-member models can be examined by estimating the depth of wrinkle ridge plains deposits by a means independent of craters. We have mapped an area extending from 23°-35° N latitude, covering over 8% of the planet. This area is composed of 37.7% material older than plains with wrinkle ridges, 10.3% material younger than the plains, and the other 52% is plains with wrinkle ridges. The plains with wrinkle ridges were separated into areas thinner and thicker than 500 meters. This depth contour was obtained by assuming that the topography of the older material underlying the plains sloped away from every surface contact with the wrinkle ridged plains at a 1% grade (0.57° angle). This will probably give an overestimate of the depth of the wrinkle ridged plains, since only 14% of the Venusian surface has regional slopes above 0.24° [5], and the only features on Venus with slopes consistently above this 0.57° value are the mountains around Ishtar Terra [6]. Using this slope assumption, 63% of plains with wrinkle ridges in this mapping area are thinner than 500 meters, and 37% are thicker than 500 meters. The depth of 500 meters was used as a cutoff value because the rims of median-size (30 km diameter) or larger craters are about 500 meters high, as deduced from topographic profiles of craters generated by Sharpton [7]. Plains thinner than 500 meters should be thin enough for the rims of median-size craters or larger to show through, so at least half of the preexisting population of craters below the plains will show through as embayed craters in these shallow areas. We will assume that plains thicker than 500 meters will have buried all underlying craters.

All of these assumptions: the steep underlying slopes, the burial of all craters in thick plains, and the burial of all small craters in thin plains, will tend to overestimate the number of craters destroyed by the emplacement of wrinkle ridged plains, thus making the resulting timespan a maximum estimate. The eight craters possibly embayed by wrinkle ridged plains occur in areas mapped in this scheme as thin plains. Five of the eight craters are larger than median diameter.

If 70% of the surface of Venus is covered by wrinkle ridged plains and 63% of these plains are thinner than 500 meters, 44% of the surface is covered by wrinkle ridged plains thinner than 500 meters. The probability is .44 that a crater emplaced randomly on the surface falls within this area. Since only craters larger than median size are guaranteed to be unburied within this area, the probability is .22 that a crater emplaced on the surface during the timespan in question will be embayed but not buried by wrinkle ridged plains. Since we observe five craters of median diameter or larger embayed by thin areas of wrinkle ridged plains, we can calculate the probability that, given a number of craters emplaced on the surface, exactly five will be larger than median diameter, in the area of thin plains. This gives an expected value of 22 craters, with a 98% confidance interval of 10-54 craters. In terms of a percentage of the mean age of the surface of Venus (300-500 Ma), the expected value is 2.4% (7-12 Ma), with a lower limit of 1% (3-5 Ma) and an upper limit of 5.8% (17-29 Ma). This timespan represents the age of the surface upon which the wrinkle ridged plains were emplaced plus the length of the emplacement of wrinkle ridged plains.

Most of the wrinkle ridged plains are thin enough that a large number of underlying craters would not have been completely buried, but only embayed by their emplacement. Since so few craters are observed to be embayed by these thin plains, they must have formed over a short time on a young surface, covering a 5-30 Ma timespan. The emplacement of these plains was not the prime mechanism for removing the ancient population of craters. An event must have occurred prior to the emplacement of these plains to erase the ancient population. Resurfacing such as tectonic resurfacing, which may have erased the ancient crater population from the tessera [8] or volcanic resurfacing by stratigraphically lower plains units, must be the primary mechanisms responsible for the young surface age observed on the surface of Venus. The wrinkle ridged plains which cover the majority of the surface of Venus are only a relatively thin veneer which formed quickly and did little to rejuvenate the surface.

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